Emittance

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Emittance dependence on beam intensity from Run-5 data

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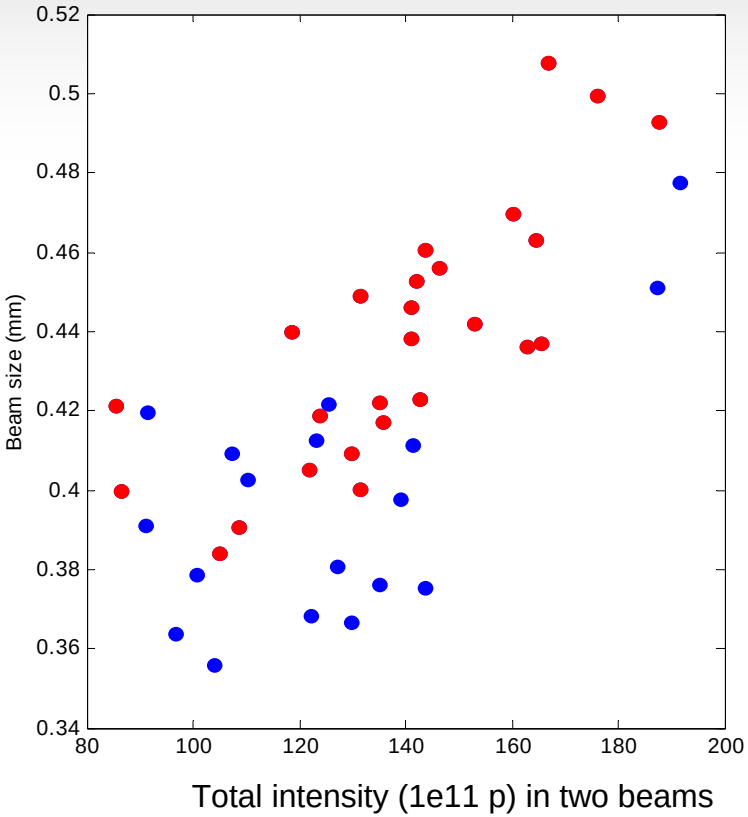
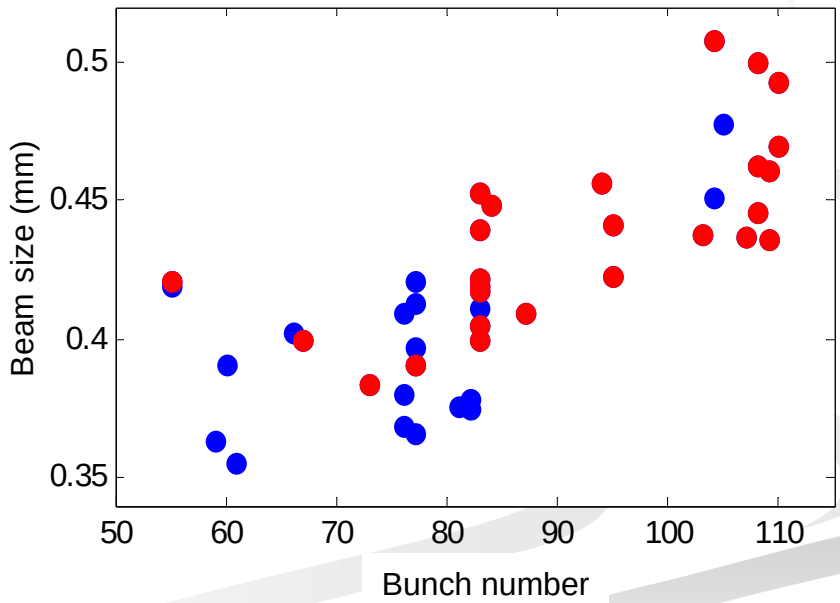
Red points corresponds to larger beam emittance from AGS



Possible sources:

1. Electron cloud
2. Injector kicker timing
3. Long-range beam-beam



Beam size is calculated using the emittance extracted from ZDC data

Run-6: emittance

- Emittance control was one of the critical items this run.
- Multiple tools for the emittance measurement have been developed: polarimeter target, ATR line flags, jet luminescence monitor.

  (+ improved IPM, Schottky, Vernier scan, AGS IPM)
- During the run the output emittance from the injectors were kept at the constant level ("golden" values), (ε_x,ε_y):

  (13;12) before the shutdown week

  (11,15) after the shutdown week

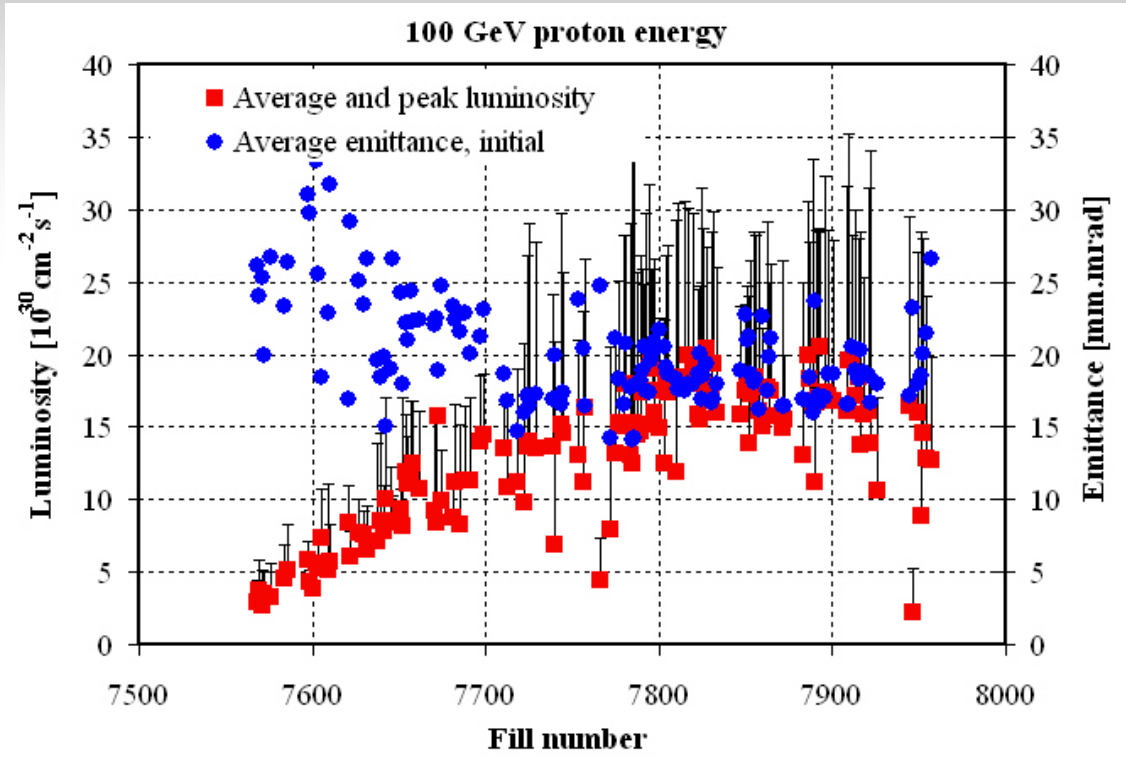
  as measured by AGS IPM (RF off)
- Regular emittance measurements were included into the procedure:
  - AGS IPM and ATR flags -> before the fill
  - polarScan -> every 2-3h during the course of the store and at the end of the store

100 GeV run: Luminosities and transverse emittances

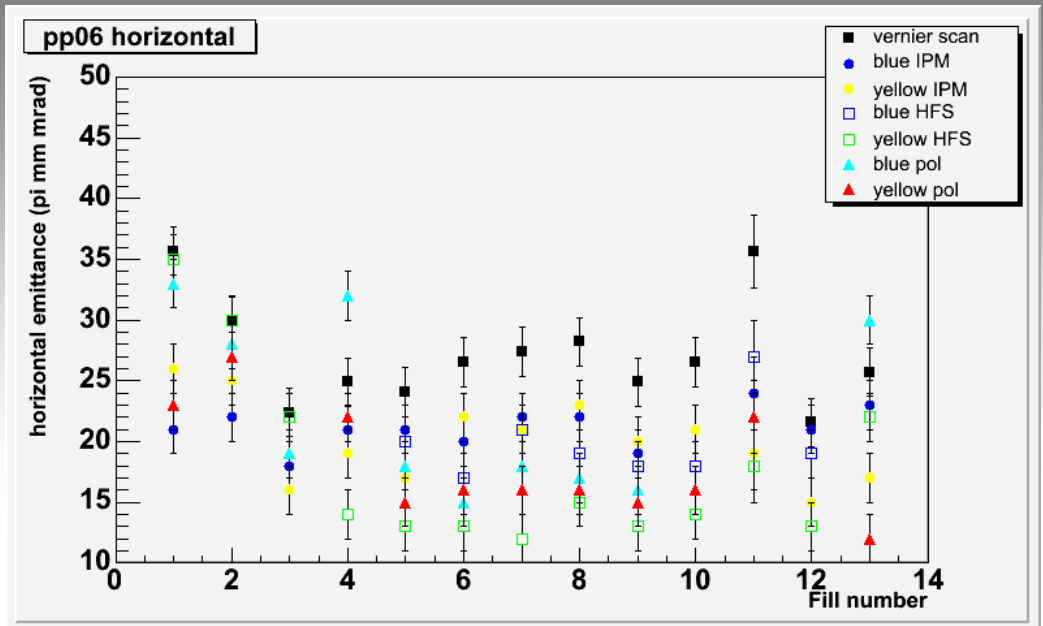
Improved transverse emittance control was important item at this run

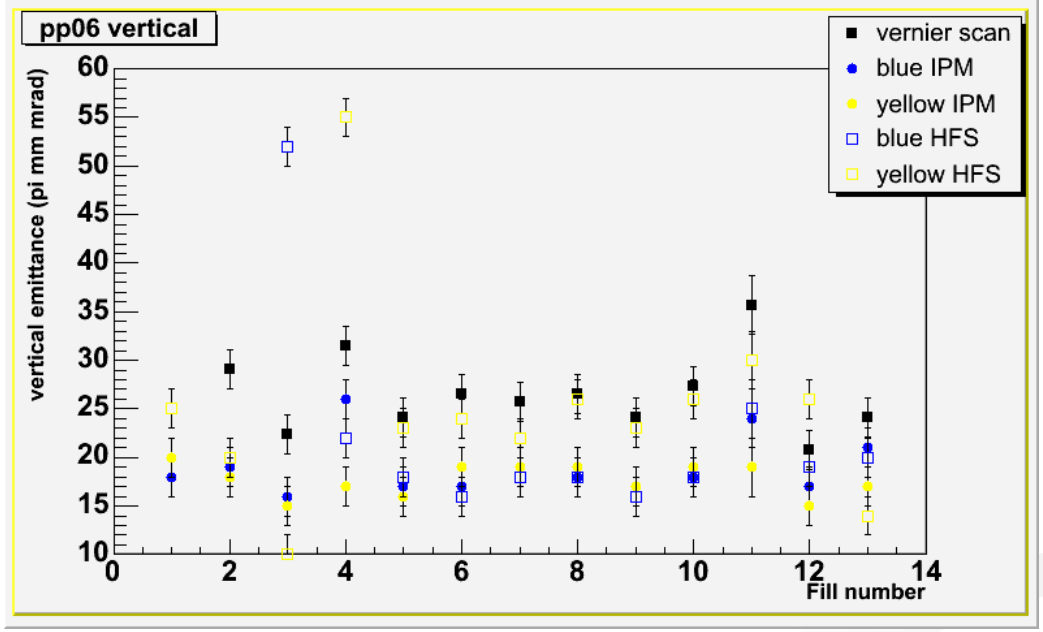
During the run the improvements to achieve smaller transverse emittance were done both in the injectors and in the RHIC:

- appropriate choice of working point
- avoiding short bunch length



Wolfram's data





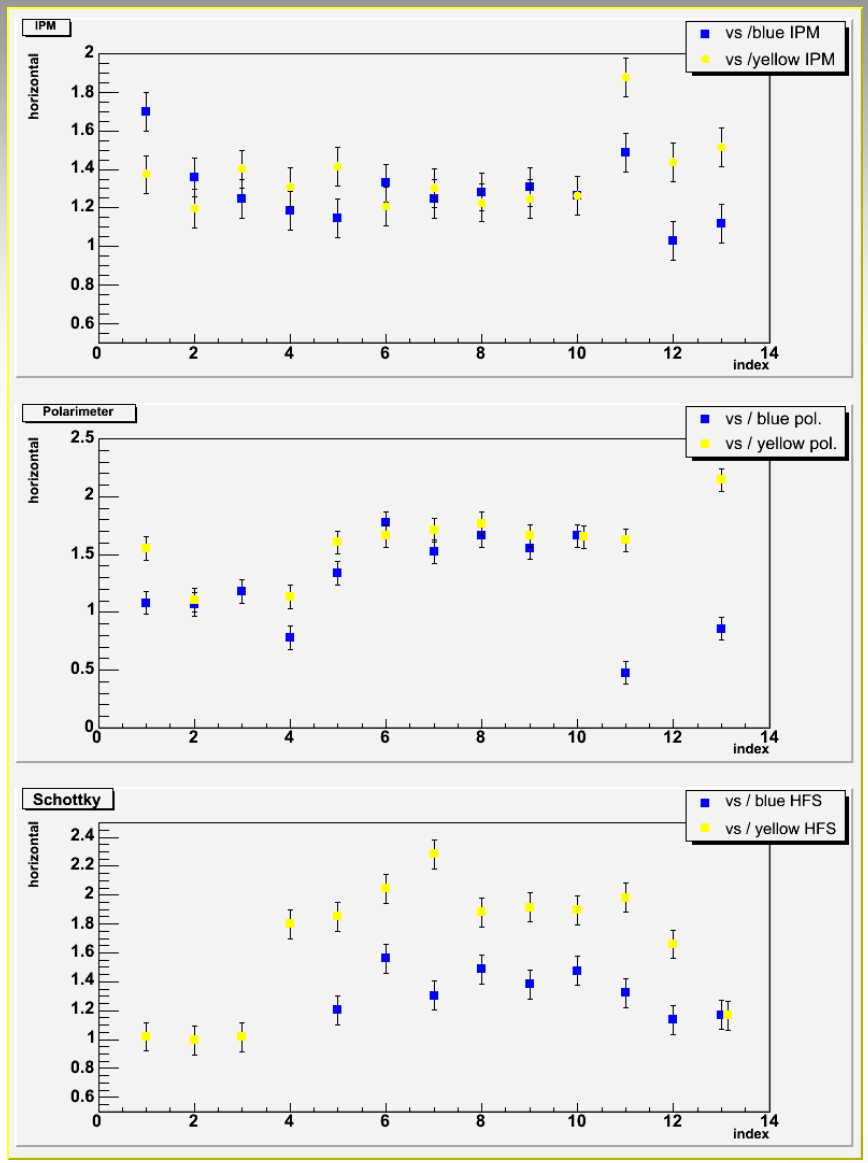
Angelika

Comparison of the emittance measurements
from Vernier scans, IPM, polarimeter and Schottky

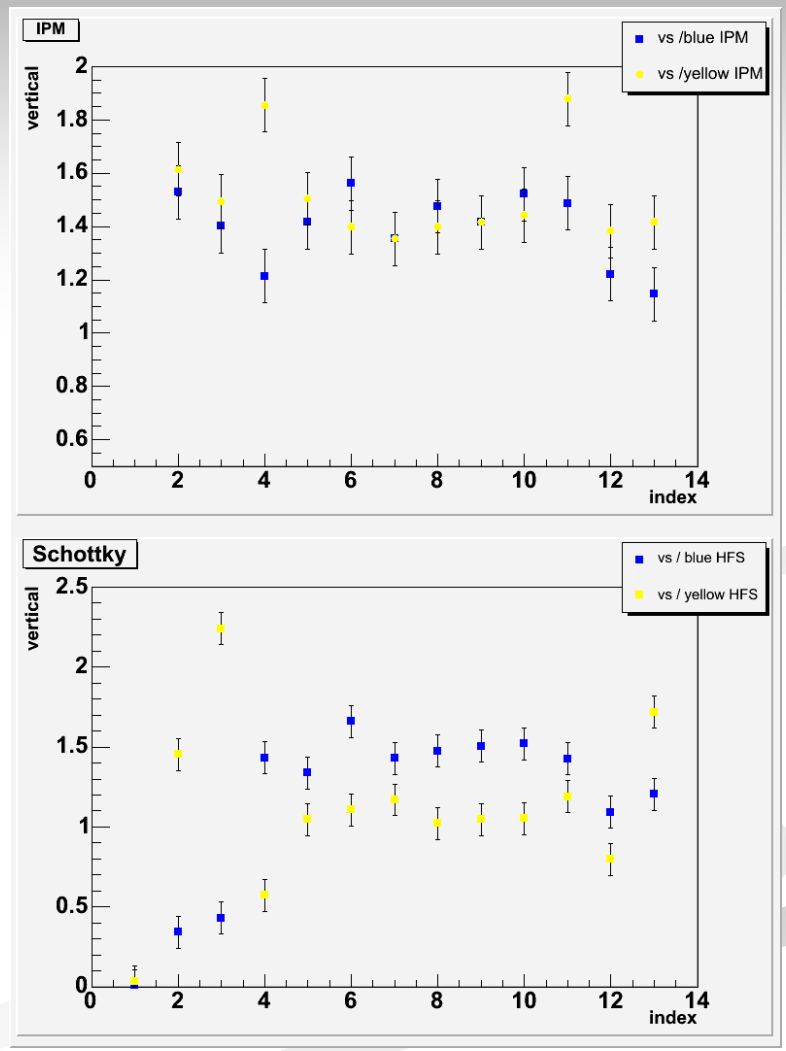
Hour-glass effect should lead to the larger emittances extracted from Vernier scans.

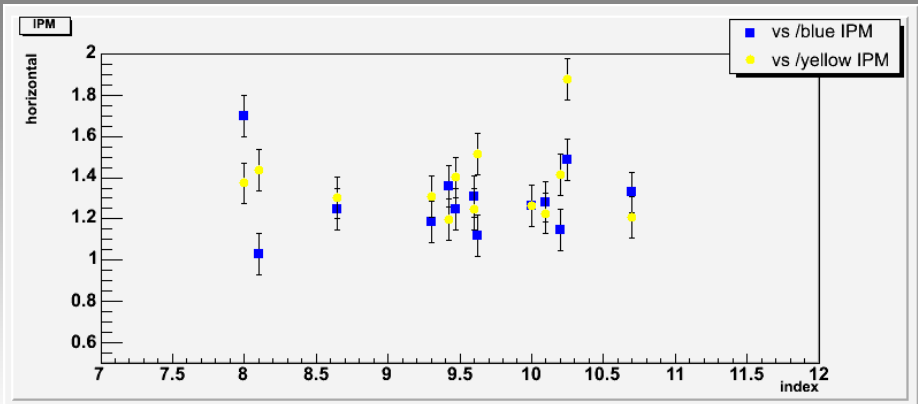
According to Vernier scans (done either at the beginning or at the end of the store) the beams are well round.

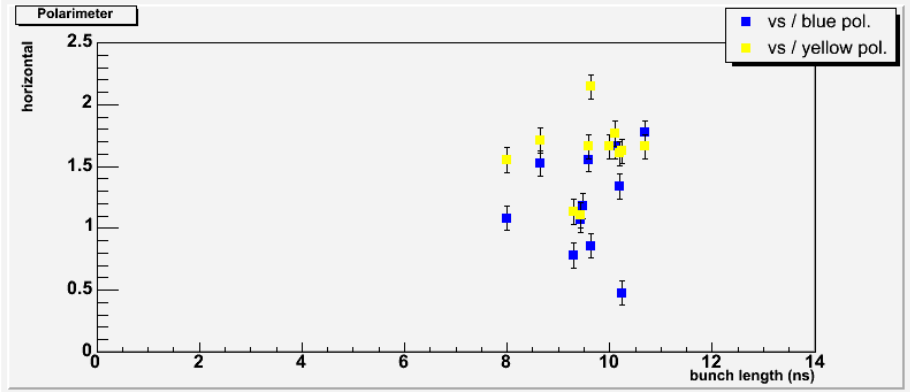
Angelika

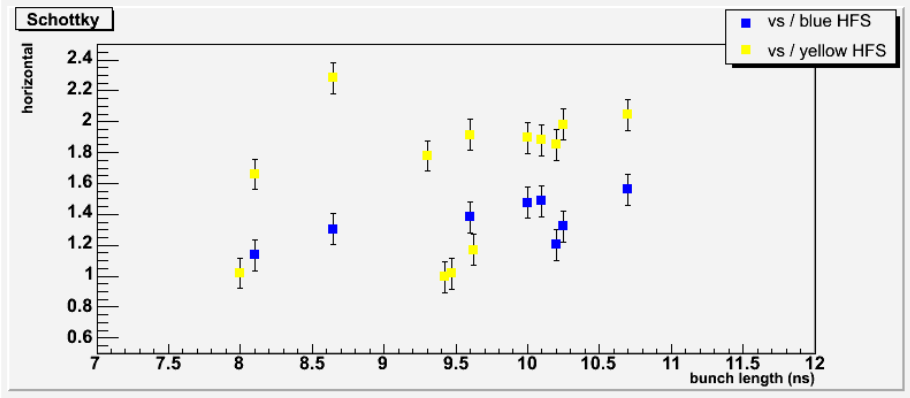


Ratios of the emittance measurements from Vernier scans to IPM, polarimeter and Schottky









Angelika

Dependences of the ratios of the Vernier Scans data to other measurements on bunch length do not support the idea that the hour-glass has much effect.

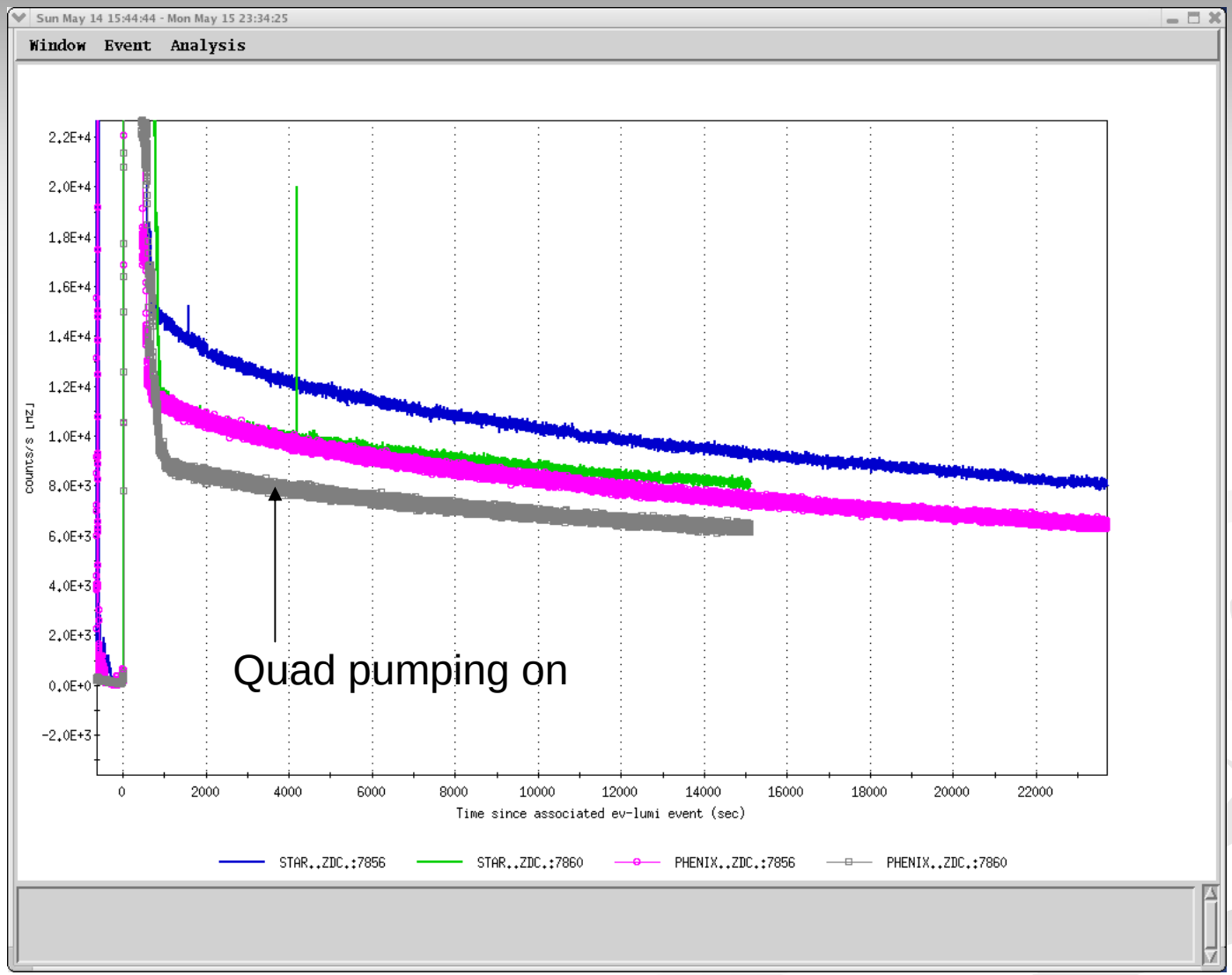
Emittance growth in RHIC

- Correlation of the transverse emittance increase with shorter bunch length was seen.

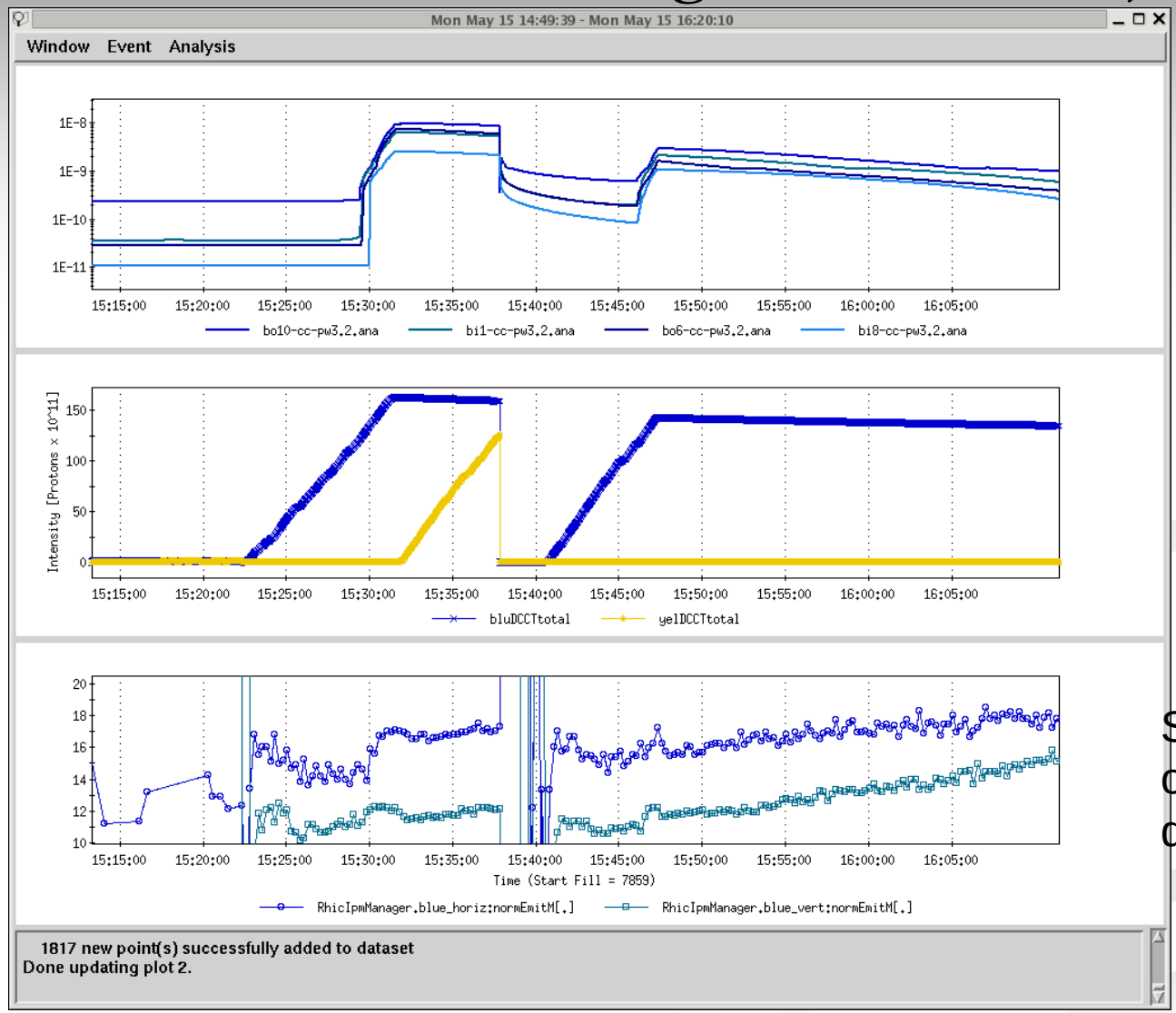
  It forced us to keep longitudinal emittance larger than it could be achieved (either by use of the “quad pumping” technique or by the injector tuning).

- Emittance growth: at the injection or on the ramp ?

Collision rates comparison for stores with and without quad pumping



Emittance growth at the injection

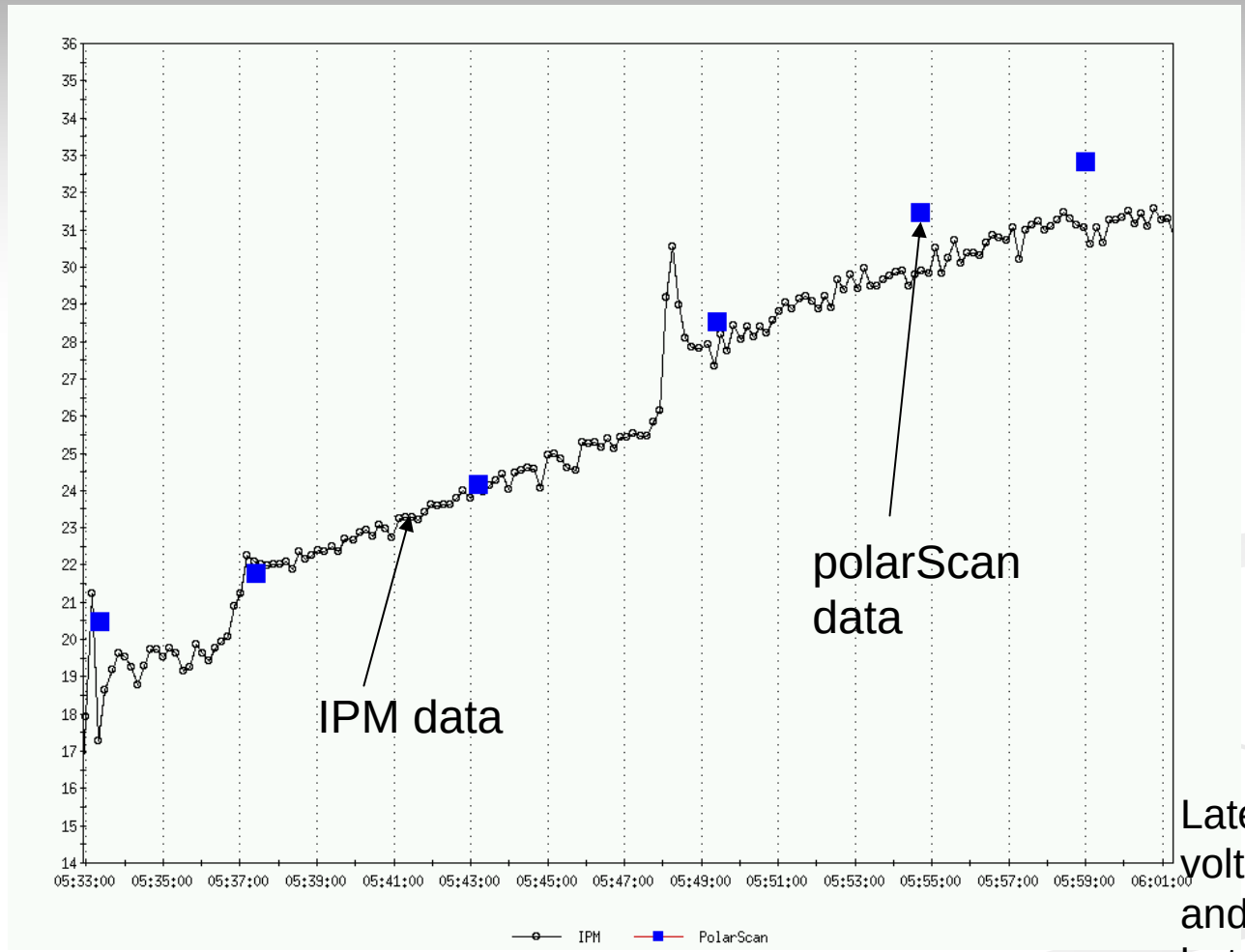


This example with quad pumping on.

It shows both step-wise emittance growth, correlated with the pressure rise, and continuous growth during the store.

Step-wise growth was seen on some stores without quad pumping.

Emittance growth due to RF voltage ramping

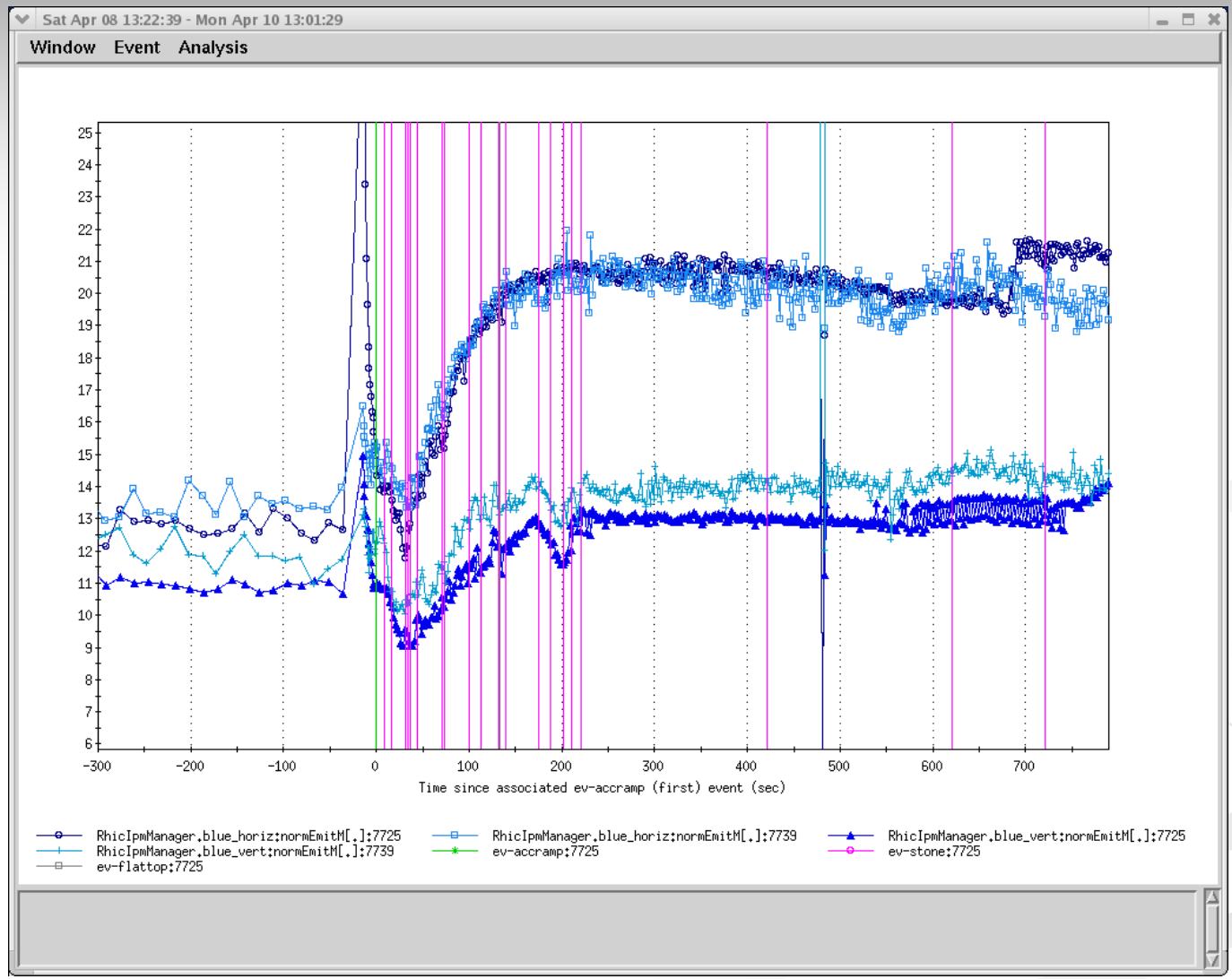


The data from beam studies (SY, Haixin, Roger Connolly, Vadim)

RF voltage ramped up from 50kV/cavity to 150 kV/cavity every ramp, just before the ramp start.

Later in the run the RF voltage ramp was rearranged and done not at the injection but during the acceleration ramp

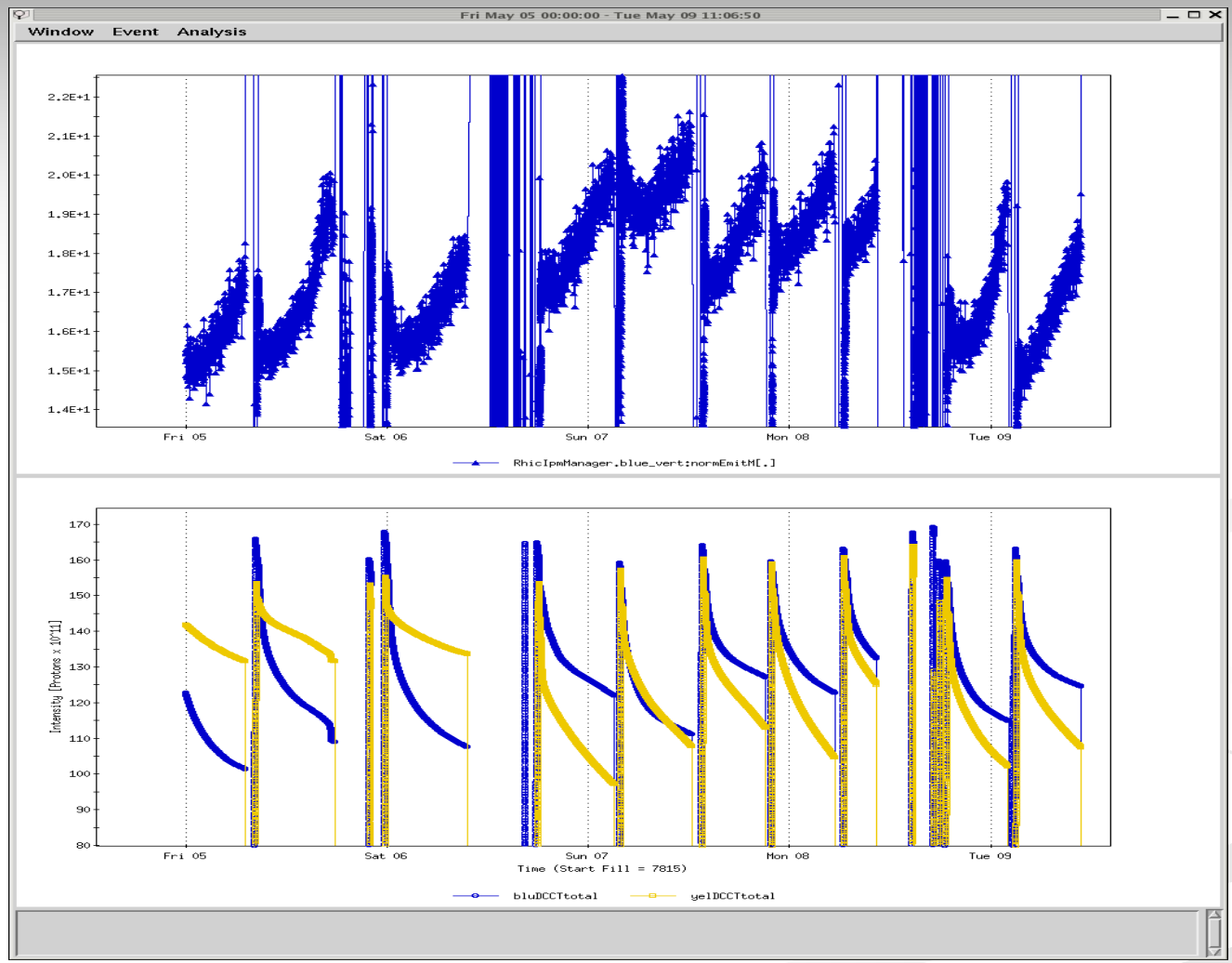
IPM data on the ramp



Is this growth real?

Still open question.

Emittance growth in the store



Conclusions

- Plenty of the transverse emittance information collected this run from different measuring devices.
- Work on comparisons of the emittance measurements from different devices continues (Angelika).
- Consistent analysis of the ATR and AGS emittance data measured over the run would be useful.

- Mechanisms of emittance growth either at the injection or on the ramp should be explained and addressed.

  Shorter bunches -> large emittance (electron cloud?).

  New rf cavity (suggested by Mike Brennan) or lower gamma-t lattice (to have smaller longitudinal emittance with longer bunches) would be helpful to minimize the emittance growth at the injection.